

Dependence of Greasing Factor of Cutting Energy and Technological Modes of Superfinishing Parts Processing

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Abstract: One of superfinishing process contradictions is the fact that the less an abrasive tool greasiness is and, therefore, the less the friction between the surfaces of a workpiece and a tool is, the more intensive the allowance removal is and the surface roughness is, and conversely, the higher an abrasive tool greasiness is, the less the allowance removal is and the smaller the workpiece surface asperities are. During superfinishing parts processing the greasing factor of the bar working surface has great influence on the value of allowance removal and surface; the greasing factor, in its turn, is significantly influenced by both the characteristics of the bar and technological processing modes.

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1. Introduction

If the greasing factor of the working surface of the bar is close to one, which can be observed at low loads applied to the bar, high bar oscillation frequency, high graininess of a tool, large working surface area of the bar and low peripheral speed of a workpiece, the cutting properties of the bar are high and it can actively remove the allowance. If these factors are of opposite value, the greasing factor of the bar working surface can be much less than one, and its cutting capacity is getting lower. [1]

The load applied to the bar influences the superfinishing process dissonantly. On the one hand, at increasing the load on the bar, as follows from the equation, the cutting energy increases, and, consequently, the allowance removal increases as well. But this dependence is valid only up to a certain value of a pressing force. With a significant increase of a pressing force, as follows from the equation, the tool greasing factor decreases and cutting energy decreases as well. At large values of load the tool greasing factor can be reduced so that the allowance removal may be close to zero. And earlier many researchers have noted the fading influence of the force of pressing the bar to the working surface to the allowance removal, but we are the first ones who have identified the most complete set of conditions for superfinishing process, which depict this influence, and can optimize these conditions.

The peripheral speed of a workpiece has the same contradictory effect on superfinishing process (and due to the same reason). With a workpiece peripheral speed increasing the cutting energy increases up to the value, at which the greasing factor is close to one. With the further increase in the

peripheral speed the greasing factor decreases, while the influence of the peripheral speed on the cutting energy and allowance removal decreases.

When the bar oscillation frequency increases, the greasing factor of the bar working surface decreases, and, therefore, allowance removal increases. However, this effect appears only up until the greasing factor is substantially less than one. If the value of this factor approaches one, the further increase of the bar oscillation frequency does not influence the processing greatly.

It should be noted that such influence of these factors is revealed mainly at small values of a tool graininess; at a high coefficient of a tool graininess the greasing factor is always close to one (under real conditions). Therefore, most types of equipment for superfinishing processing are constructed so that at the first stage of processing a coarse tool is used, thus providing the required allowance removal, and at the second stage the processing is usually performed with a fine-grained tool, achieving smaller surface roughness.

On the basis of dependency proposed by us it is real now to process a workpiece at one position with a fine-grained tool providing appropriate allowance removal and desired surface roughness. It improves the processing performance and simplifies the processing technological means being used [2, 3, 4, 5, 6, 7, 8, 9, 10].

In figure 1 the dependence of the cutting energy on the value of greasing factor is shown. The graphs show that an increase in the greasing factor leads to an increase in cutting energy for three values of a tool graininess, which is understandable, i.e. the

number of active cutting grains increases, thus allowance removal is increased.

The performed researches of dependence of the greasing factor on technological modes of processing have shown that an increase of the pressing force applied to the bar significantly reduces the greasing factor, especially if a fine-grained tool is used.

$$U_{tz} \text{ (J)}$$

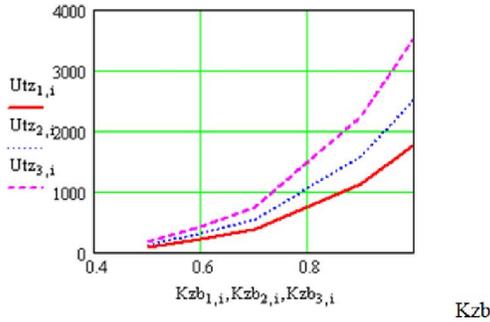


Fig.1. Dependence of cutting energy U_{tz} (J) on the greasing factor Kzb at different graininess: 1 - M7, 2 - M14, 3 - M28

If at an increase of tool pressing force from 100 to 1000 N the greasing factor of the bar of M28 graininess decreased from 0.9 to 0.65, then the greasing factor of the bar of M7 graininess decreased significantly greater – from 0.83 to 0.33, which directly affects the value of allowance removal, decreasing it (Fig. 2).

$$Kzb$$

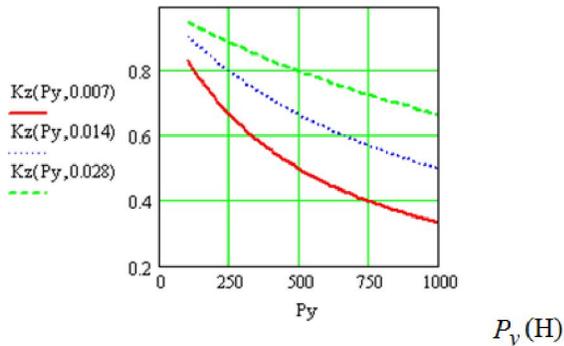


Fig.2. Dependence of the greasing factor Kzb on the bar pressing force P_y (N) at different graininess: 1 - M7, 2 - M14, 3 - M28

The opposite picture can be observed with an increase of the bar oscillation frequency. In this case, the value of the greasing factor increases due to more favorable conditions for a tool working surface

cleaning (and as a result an increase of allowance removal). At that the most optimum value of the oscillation frequency for an increase of an allowance removal at various graininess of a tool ranges from 10 to 30 Hz, and for a reduction of treated surfaces roughness the oscillation frequency should be less than 10 Hz [5,6] (Fig. 3).

$$Kzb$$

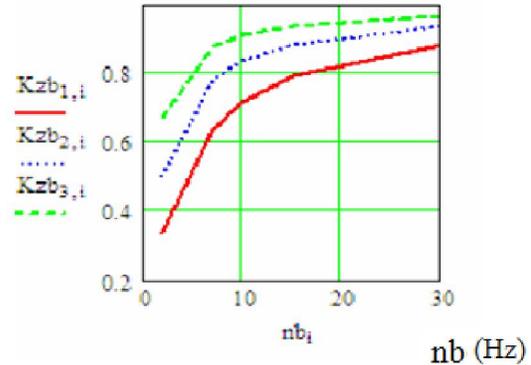


Figure 3. Dependence of the greasing factor Kzb on the bar oscillation frequency nb (Hz) at different graininess: 1 - M7, 2 - M14, 3 - M28

Thus the greasing factor characterizes the cutting process at bar processing, and, managing it through a tool pressing force and the bar oscillation frequency at a given graininess of a tool, you can adjust the value of allowance removal or the value of treated surfaces roughness, at that the change of the greasing factor during the processing determines a corresponding change of spent cutting energy.

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